

Lecture 07 - Image Descriptors

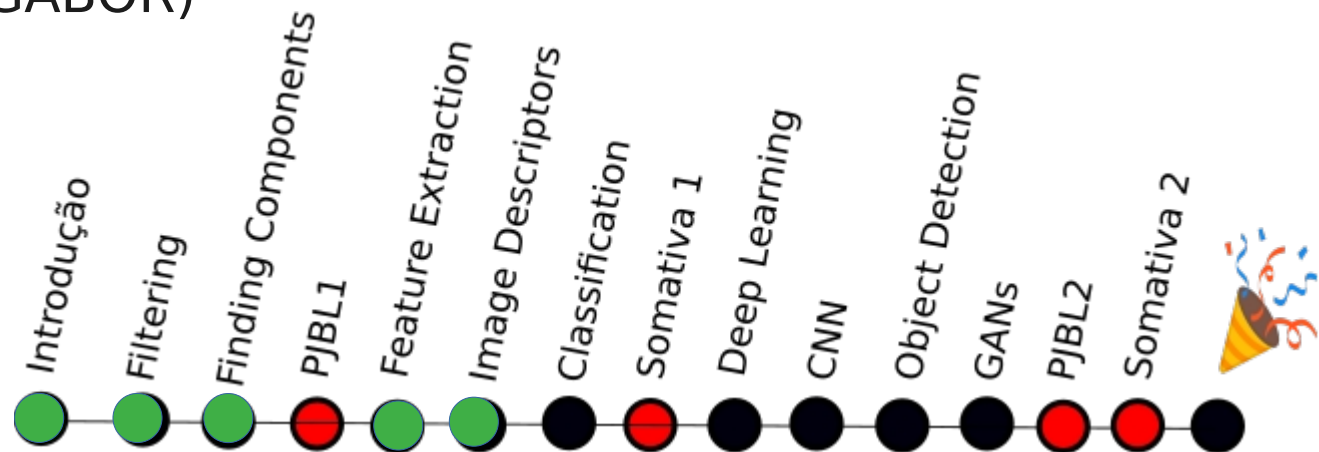
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Topics

- Discussion of Lecture #06
 - Feature Vector
 - Horizontal and Vertical Projections
- Image Descriptors
 - Shape (HoG)
 - Textures (LBP, GABOR)
- Classification
 - K-NN
- Practice



Computer Vision & Pattern Recognition Pipeline

PATTERN RECOGNITION SYSTEM

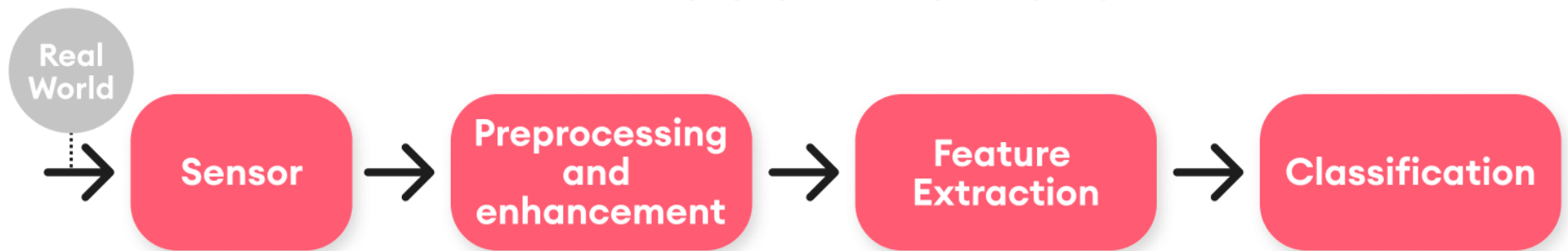


Image Descriptors - Shape

- Moments

- Values that carry both spatial and intensity information
 - Weighted average of all pixel's intensities
 - $I(x,y)$ pixel coordinates of input
 - Powers, p and q , are the weights of the horizontal and vertical dimensions

$$M_{pq} = \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} x^p y^q I(x, y)$$

- HuMoments (Hu 1962)

- Translation and Scale Invariant

$$h_1 = \eta_{20} + \eta_{02}$$

$$h_2 = (\eta_{20} - \eta_{02})^2 + 4(\eta_{11})^2$$

$$h_3 = (\eta_{30} - 3\eta_{12})^2 + 3(\eta_{03} - 3\eta_{21})^2$$

$$h_4 = (\eta_{30} + \eta_{12})^2 + (\eta_{03} + \eta_{21})^2$$

$$h_5 = (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{03} + \eta_{21})^2] + (3\eta_{21} - \eta_{03})(\eta_{03} + \eta_{21})[3(\eta_{30} + \eta_{12})^2 - (\eta_{03} + \eta_{21})^2]$$

$$h_6 = (\eta_{20} - \eta_{02})[(\eta_{30} + \eta_{12})^2 - 7(\eta_{03} + \eta_{21})^2] + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{03} + \eta_{21})$$

$$h_7 = (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{03} + \eta_{21})^2] + (\eta_{30} - 3\eta_{12})(\eta_{03} + \eta_{21})[3(\eta_{30} + \eta_{12})^2 - (\eta_{03} + \eta_{21})^2]$$

Image Descriptors - Shape

- HoG - Histogram of Oriented Gradients
 - Computes the gradient and orientation of edges
 - Use a kernel to compute the Gradients (i.e 9x1)
 - Patch-Based Histogram (8x8, 16x16..)

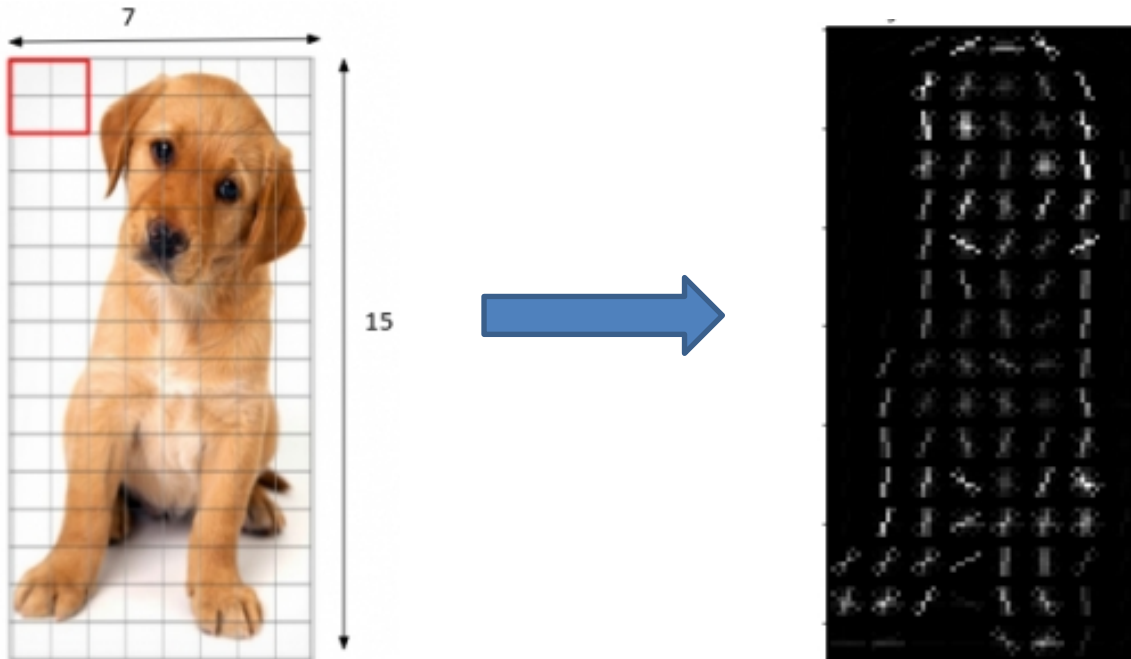


Image Descriptors - Texture

- Gabor Filters
 - Convolves the image using several Gaussian Kernels (Kernel Bank)

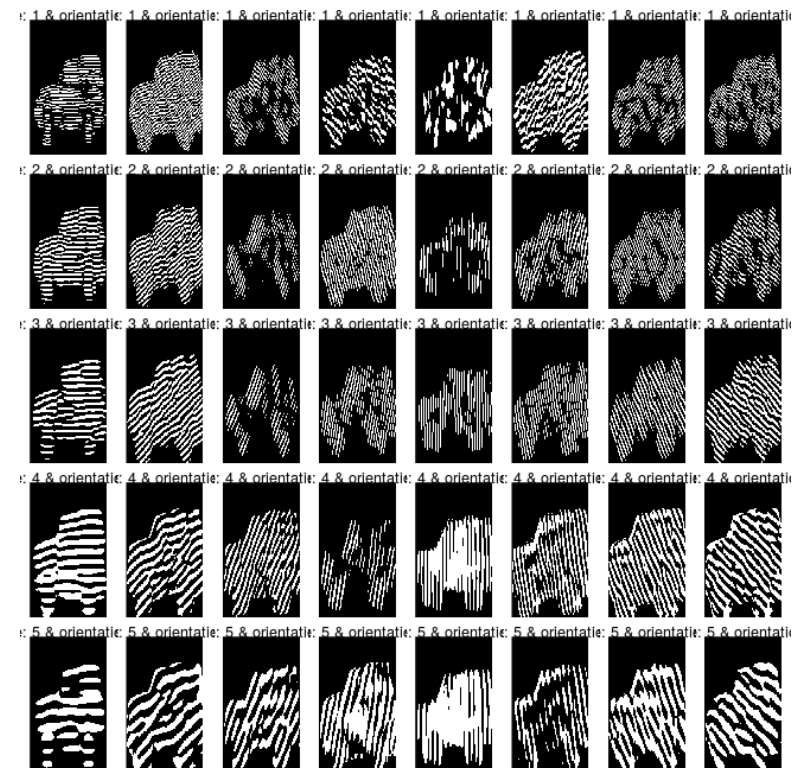
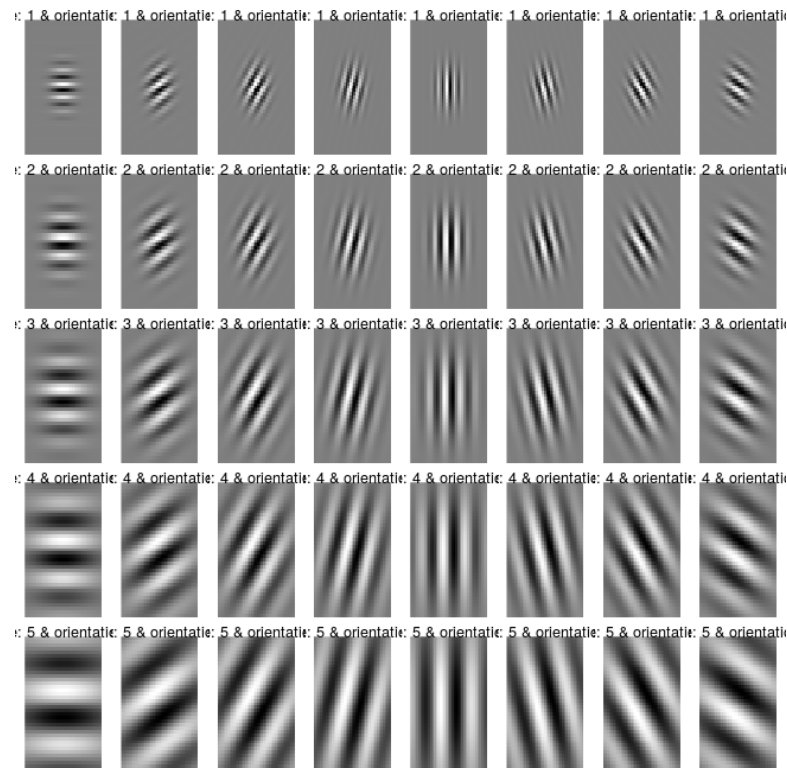
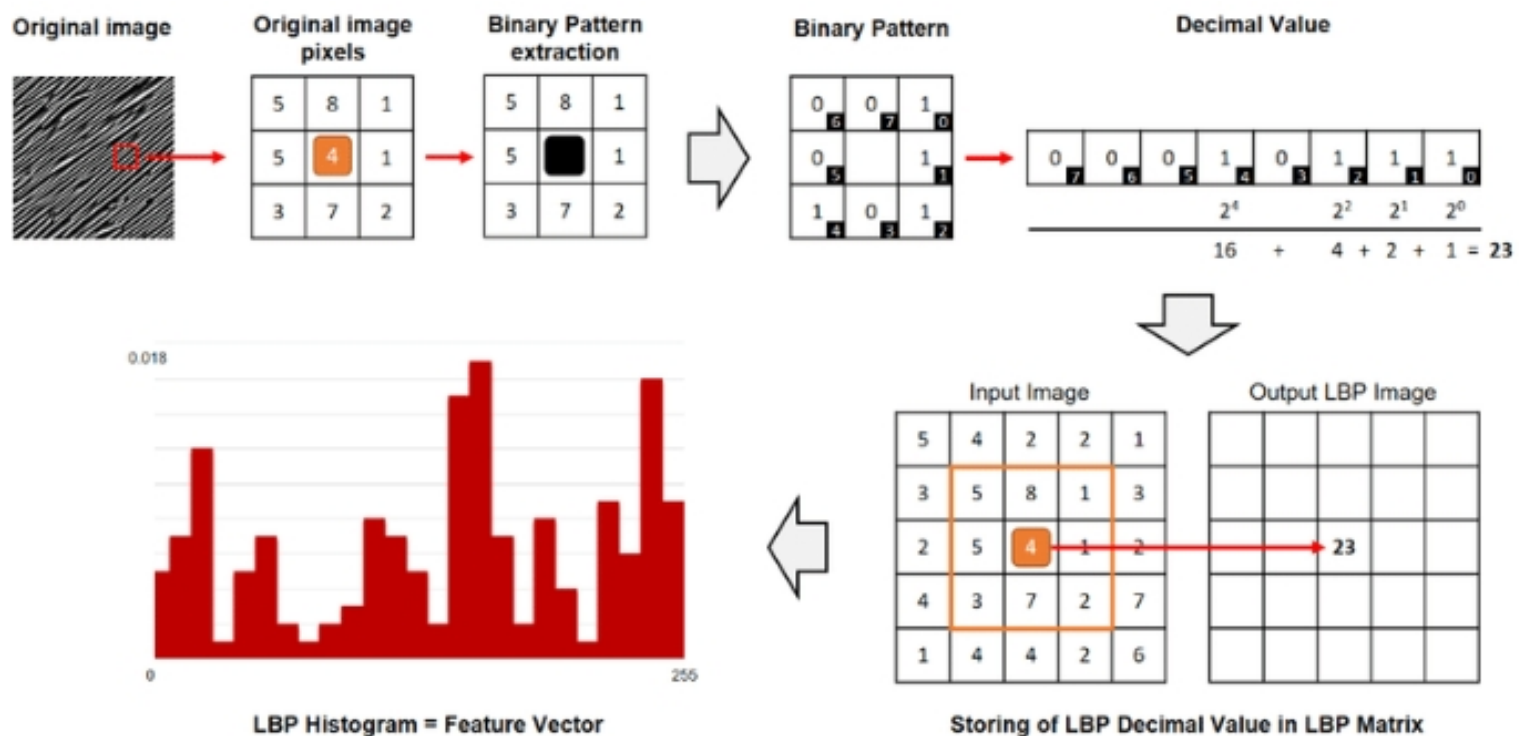
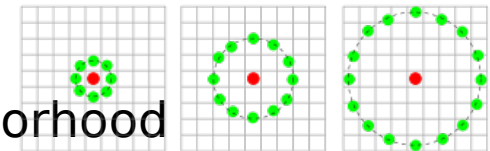


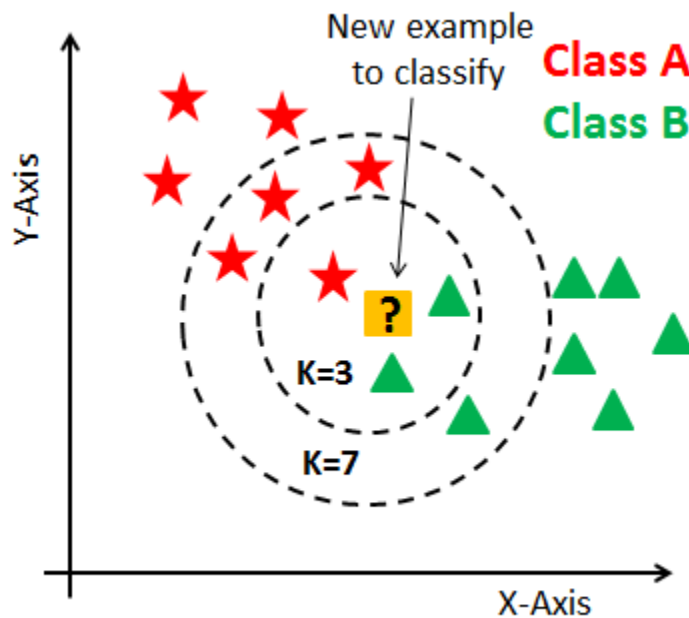
Image Descriptors - Texture

- Local Binary Patterns
 - Convolve the image using a Circular Kernel
 - The resulting pixel is computed in the binary neighborhood



Classification

- KNN
 - Computes the similarity in a feature space (Euclidian Distance, Manhattan....)
 - The K-Nearest Neighbors determines the class (Majority Vote)



$$d(x,y) = \sqrt{\sum_{i=1}^n (y_i - x_i)^2}$$

Let's Code

- [LINK](#)